



# PROJECT PROGRESS REPORT

**PREPARED FOR THE ALASKA ENERGY AUTHORITY BY  
THE ALASKA CENTER FOR ENERGY AND POWER**

**PROJECT TITLE:** *Round 1: Emerging Energy Technology Fund – Data Collection*

**REPORTING PERIOD:** 4<sup>th</sup> Quarter 2016

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## ***EETF Round 1 Projects***

### **Project #003 – Alaska Division of Forestry, Biomass Reforestation**

This project is complete, and a final report from the Division of Forestry is forthcoming. Of particular interest is the additional data that was to be collected this past fall.

### **Project #006 – Arctic Sun, Arctic Thermal Shutters and Doors**

This project has reached completion. ACEP has completed its final report with input from AEA and will be publishing it in glossy format in the spring of 2017.

### **Project #009 – Genesis – Ultra-Efficient Generators and Diesel-Electric Propulsion**

This project was concluded at its current stage of development. ACEP has received additional data and awaits the final report. ACEP will communicate with AEA about final reporting activities.

### **Project #026 – Cold Climate Housing Research Center (CCHRC), Ground Source Heat Pump (GSHP)**

It appears the ground source heat pump at CCHRC continues to operate. Recent analysis noticed a discrepancy in the latest COP numbers. They were not in line with what was expected. Rather than report these numbers, we are currently reaching out to CCHRC to determine if something has changed with either the data files or the data sensors. When the issue is located, ACEP will send a revised data collection update for this project.

The ground sensor temperatures for the ground loops are shown in Figure 1. The loop temperatures appear to be in line with past heating seasons.

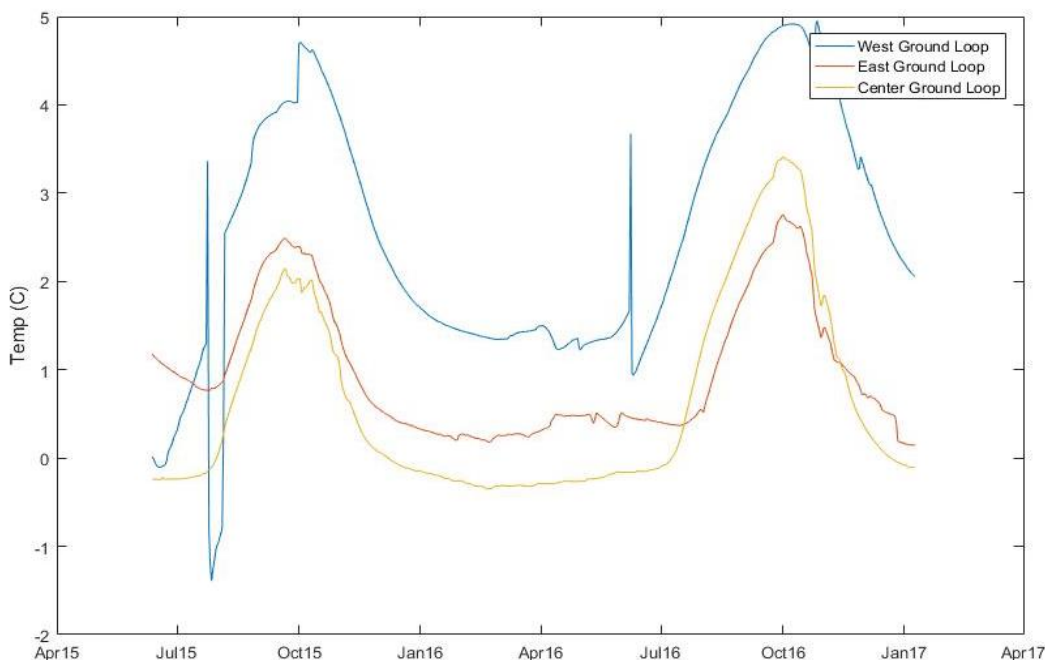


Figure 1: CCHRC GSHP ground loop sensor temperatures vs. time

Project #028 – University of Alaska Fairbanks (UAF), Organic Rankine Cycle (ORC)

ACEP has received additional data in response to its questions, and analysis is ongoing. ACEP will be issuing a draft of the final report in spring of 2017.

Project #029 – University of Alaska Fairbanks, Exhaust Thimble

This project has reached completion. ACEP has completed its final report with input from AEA and will be publishing it in glossy format in the spring of 2017.

Project #035 – Altaeros, Airborne Wind Turbine

According to its final report submitted to AEA, the Altaeros project team completed site selection, turbine design and testing, and initial safety and shakedown testing of the flight platform without the turbine. It should be noted that full load testing was not completed for the turbine, and the full-scale generator and power conditioning system were not built or tested. No data were transmitted to ACEP for analysis. ACEP will discuss with AEA next steps and final reporting obligations.

Project #037- Oceana, Hydrokinetics; Project #043 – Ocean Renewable Power Corporation (ORPC), Hydrokinetics; Project #058 – Boschma Research Inc. (BRI), Hydrokinetics

These projects have reached completion. ACEP has completed its final report with input from AEA and will be publishing it in glossy format in the spring of 2017.

Project #045 – Hatch, Flywheel

This project has reached completion. ACEP has completed its final report with input from AEA and will be publishing it in glossy format in the spring of 2017.

Project #049 – Intelligent Energy Systems (IES), Self-Regulated Grid; Project #051 – Intelligent Energy Systems (IES), Wind-Diesel-Battery Hybrid System

To date ACEP has received the following data channels from IES:

*Kwigillingok Wind Diesel battery Hybrid system*

March 6, 2015-February 16, 2016

Channel Name	Resolution
AirTemp	1 min
Time	1 min
BESS_Hz	1 min
BESS_kVAR	1 min
BESS_kW	1 min
BESS_SOC	1 min
BESS_SOH	1 min
BESS_VLL	1 min

ETS_kW	1 min
ETS_SOC	1 min
G1_kVAR	1 min
G1_kW	1 min
G2_kVAR	1 min
G2_kW	1 min
G4_kVAR	1 min
G4_kW	1 min
LR_kW	1 min
Mode	1 min
SS_kW	1 min
TotalWind_kW	1 min
CalculatedVillageLoad_kW	1 min
WindSpeed_mph	1 min

4 seconds of very high resolution data from Feb 2015

Channel Name	Resolution
Timestamp	~960HZ
IA	~960HZ
IB	~960HZ
IC	~960HZ
Freq	~960HZ
VA_V	~960HZ
VB_V	~960HZ
VC_V	~960HZ

April –October 2015

Channel Name	Resolution
Time	1 second
BESS_kVAr	1 second
BESS_kW	1 second
BESS_Hz	1 second
BESS_V_LL	1 second

Consistent with ACEP’s role in the EETF program, the data submitted for the Kwigillingok project will allow the following analysis as part of a final report:

- Diesel-off performance during period for which data has been submitted
- Wind velocity at which diesel-off occurred
- Amount of time diesel generators were off during the study
- Power Quality issues during transitions if they are observable at the reported data resolutions
- Approximate fuel offsets

- Performance during different “modes” (diesel-on vs. diesel-off)
- Number of outages in diesel-on mode compared with diesel-off mode
- Filter for outages as different loads were added, i.e. school grinder pumps, etc.
- Time to recover from outages

*Tuntutuliak Self Regulating Grid*

May 7, 2015- September 20, 2016

Channel name	Resolution
TIMEfv	10 min
PQM_V_CA_MIN	10 min
PQM_V_CA_MAX	10 min
PQM_V_CA_AVG	10 min
PQM_V_BC_MIN	10 min
PQM_V_BC_MAX	10 min
PQM_V_BC_AVG	10 min
PQM_V_AB_MIN	10 min
PQM_V_AB_MAX	10 min
PQM_V_AB_AVG	10 min
PQM_KVA_MIN	10 min
PQM_KVA_MAX	10 min
PQM_KVA_AVG	10 min
PQM_HZ_MIN	10 min
PQM_HZ_MAX	10 min
PQM_HZ_AVG	10 min

Channel name	Resolution
TIMEETS	10 min
ETS_State_of_Charge_MIN	10 min
ETS_State_of_Charge_MAX	10 min
ETS_State_of_Charge_AVG	10 min
ETS_Setpoint_MIN	10 min
ETS_Setpoint_MAX	10 min
ETS_Setpoint_AVG	10 min
ETS_Max_kW_MIN	10 min
ETS_Max_kW_MAX	10 min
ETS_Max_kW_AVG	10 min
ETS_Current_kW_MIN	10 min
ETS_Current_kW_MAX	10 min
ETS_Current_kW_AVG	10 min

Channel name	Resolution
TIMEkW	10 min
T1_KW_AVG	10 min

T1_KW_MAX	10 min
T1_KW_MIN	10 min
T2_KW_AVG	10 min
T2_KW_MAX	10 min
T2_KW_MIN	10 min
T3_KW_AVG	10 min
T3_KW_MAX	10 min
T3_KW_MIN	10 min
T4_KW_AVG	10 min
T4_KW_MAX	10 min
T4_KW_MIN	10 min
T5_KW_AVG	10 min
T5_KW_MAX	10 min
T5_KW_MIN	10 min
EPMF_KW_AVG	10 min
EPMS_KW_AVG	10 min
G1_KW_AVG	10 min
G1_KW_MAX	10 min
G1_KW_MIN	10 min
G2_KW_AVG	10 min
G2_KW_MAX	10 min
G2_KW_MIN	10 min
G3_KW_AVG	10 min
G3_KW_MAX	10 min
G3_KW_MIN	10 min
G4_KW_AVG	10 min
G4_KW_MAX	10 min
G4_KW_MIN	10 min
LR_Measured_Power_AVG	10 min
LR_Measured_Power_MAX	10 min
LR_Measured_Power_MIN	10 min
Main_Village_Load_AVG	10 min
Main_Village_Load_MAX	10 min
Main_Village_Load_MIN	10 min

4 hours of data before and after the SRG was commissioned

<b>With SRG 2 to 8</b>	<b>12/13/2015</b>
<b>Channel Name</b>	<b>Resolution</b>
Date/Time	<b>4 Hz</b>
Vrms ph-ph AB Avg	<b>4 Hz</b>
Vrms ph-ph BC Avg	<b>4 Hz</b>
Vrms ph-ph CA Avg	<b>4 Hz</b>
Current A Avg	<b>4 Hz</b>

Current B Avg	<b>4 Hz</b>
Current C Avg	<b>4 Hz</b>
Frequency Avg	<b>4 Hz</b>
<b>No SRG 8 to 2PM</b>	<b>1/15/2015</b>
<b>Channel Name</b>	<b>Resolution</b>
Date/Time	<b>4 Hz</b>
Vrms ph-ph AB Avg	<b>4 Hz</b>
Vrms ph-ph BC Avg	<b>4 Hz</b>
Vrms ph-ph CA Avg	<b>4 Hz</b>
Current A Avg	<b>4 Hz</b>
Current B Avg	<b>4 Hz</b>
Current C Avg	<b>4 Hz</b>
Frequency Avg	<b>4 Hz</b>

Consistent with ACEP's role in EETF program, the data submitted for the Tuntutuliak project will allow the following analysis as part of a final report:

- Line to line voltages during times of high wind and high ETS loads
- Rough Quantification of fuel savings in terms of fuel for electrical generation and home heat from ETS units
- Identification of periods of grid failure
- Analysis of power quality at various penetrations of renewable energy.

ACEP will attempt to get kVAR Avg, min, and max from main bus to calculate power factor during various ETS loads.

#### Project #061 – Marsh Creek, Various Speed Diesel-Electric Generation

ACEP awaits final materials from Marsh Creek.

#### Additional Project – Northwest Arctic Borough, Arctic Field Testing and Power Curve Verification of Eocycle 25 kW Wind Turbine

During the final quarter of 2016, ACEP received two months of performance data from the Eocycle wind turbine in Kotzebue. According to Eocycle, the turbine was stopped by Eocycle on November 17 due to icing. Eocycle reports that they are waiting on correspondence with Kotzebue Electric Association to restart the turbine. Ingemaar Mathiasson of the Northwest Arctic Borough is attempting to contact staff in Kotzebue to verify the system status. Prior to mid-November, the turbine appeared to be functioning normally. Figure 1 shows the hourly wind speed over time, since the commencement of data collection.

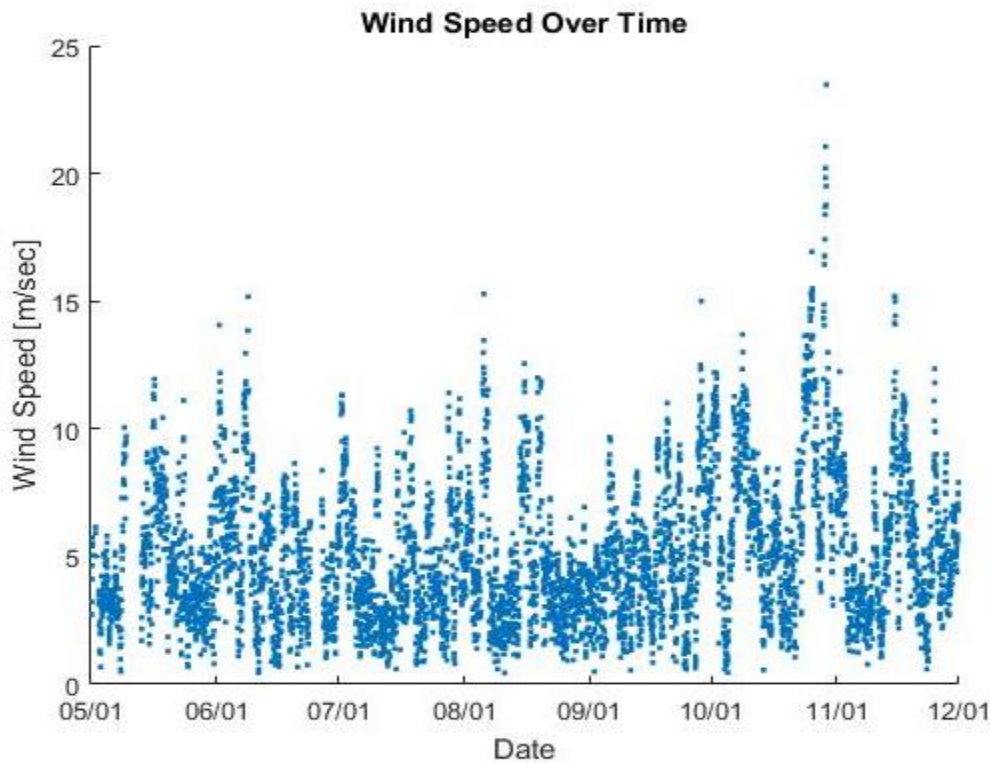


Figure 1: Hourly wind speed graph for Eocycle turbine

Figure 2 shows the daily energy production along with daily average wind speed. The maximum energy produced in a day was approximately 475 kWh, and the average wind speed on this day (October 25, 2016) was 12 m/sec. The capacity factor on this day was approximately 80%.

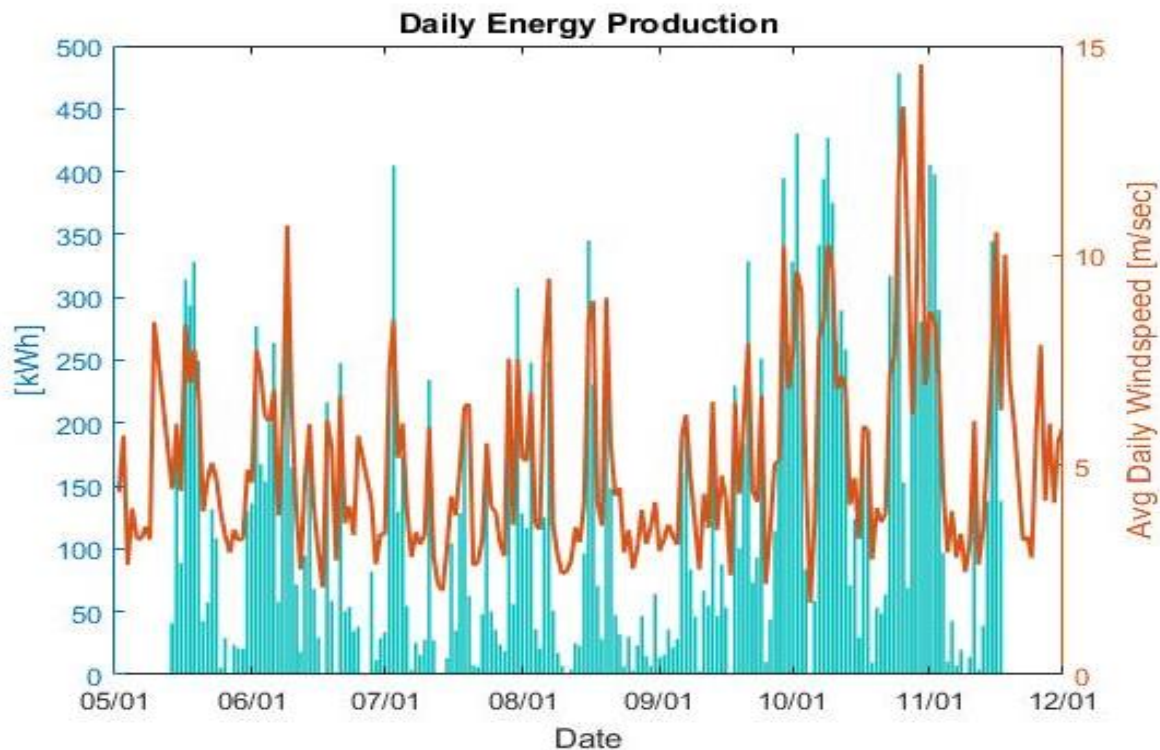


Figure 2: Daily energy production and average windspeed vs. time for Eocycle turbine

The power curve in Figure 3 is calculated using ten minute data collected to date.

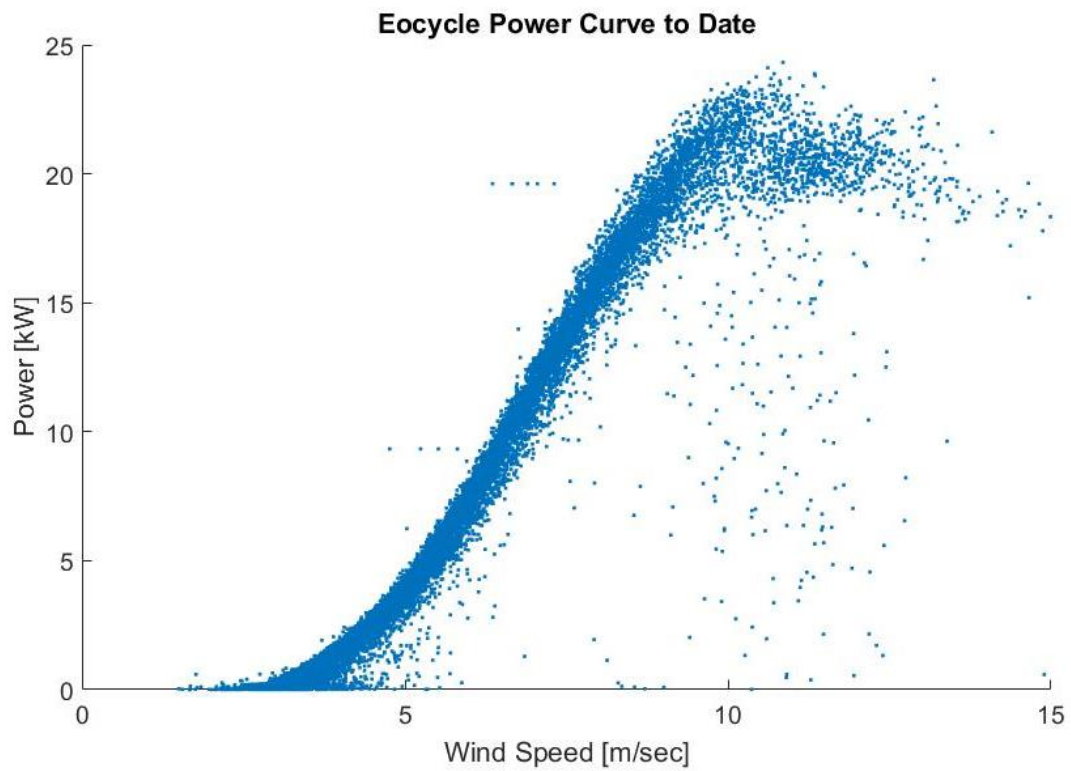


Figure 3: Power curve for Eocycle wind turbine using 10-minute data collected to date.